Bickerdike Allen Partners

25 CHURCH ROAD, SE19

ENTERTAINMENT NOISE ASSESSMENT

Report to
Kayode Falebita
Kingsway International Christian Centre
3 Hancock Road
Bromley-By-Bow
London
E3 3DA

A9540/R01-A-HT

26/07/2012

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APPENDICES

1.0 INTRODUCTION

Bickerdike Allen Partners (BAP) have been retained by Kayode Falebita to carry out an investigation into the noise breakout from a multi-purpose venue at 25 Church Road, London. The site will generally be used for conferences, concerts and other community based activities with a potential future use as a place of worship.

The site has not begun full operation and therefore hopes to use this assessment to establish and mitigate any noise related issues before this occurs.

This report sets out the required noise study along with recommendations to meet typical requirements. A glossary of acoustical terminology used can be found in Appendix A.

2.0 SITE DETAILS

The building is a converted cinema situated in a mixed residential and commercial area in Crystal Palace, Bromley. A plan of the site can be seen in Figure 1.

The layout of the building comprises of an open foyer area which leads into the main section of the building, split over two levels housing a large balcony and tiered seating at first floor level. The west façade of the building runs along the relatively busy Church Road which houses a number of commercial properties. The east façade is far more sheltered and faces a number of residential properties. Due to the topography of the area, these eastern properties have a lower ground elevation to the building, rendering them well sheltered to traffic noise on Church Road.

The external envelope of the building consists of 225 mm solid brickwork, there are two fire exits, one on the east façade and one on the west façade, the exits consist of poorly sealed timber double doors. Two single glazed windows were also present in the envelope (one on each façade), as were several air bricks and louvred grills.

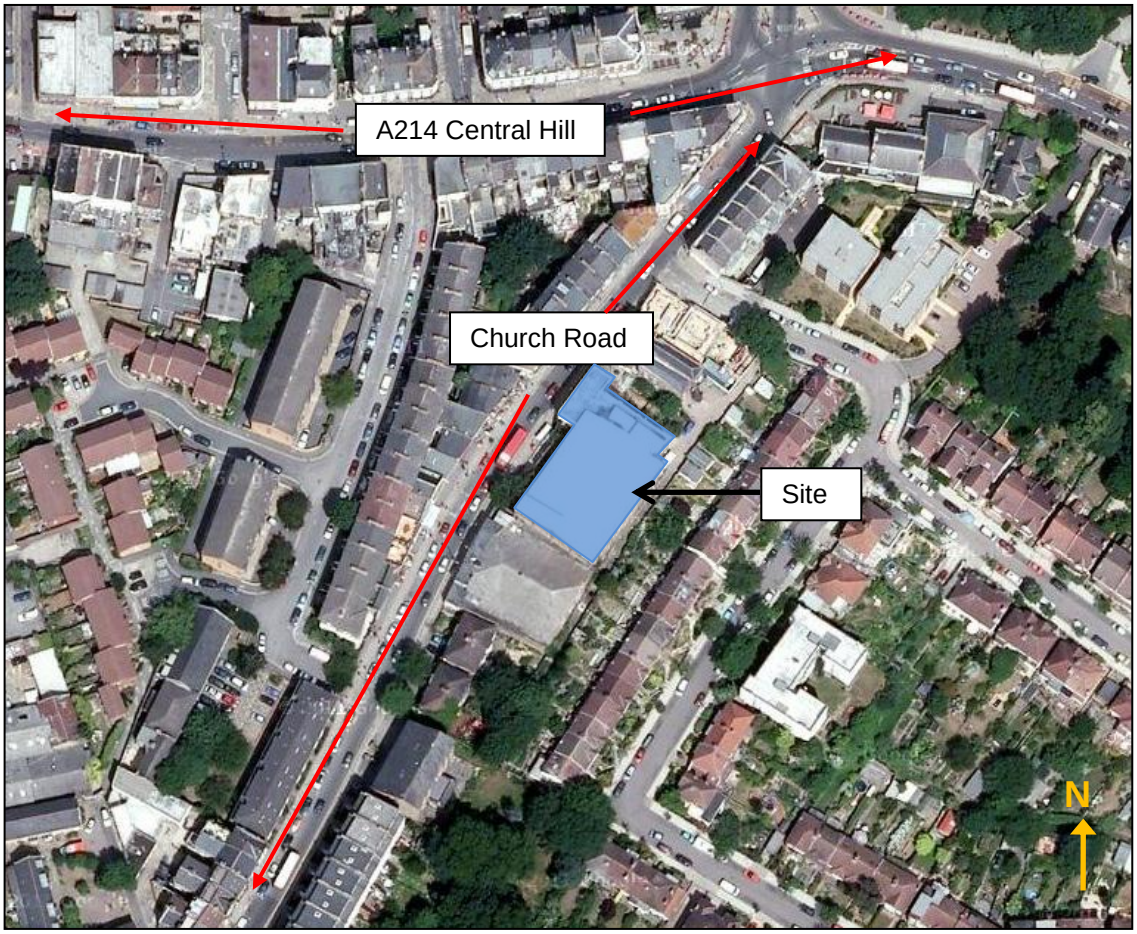

Figure 1 – Map of the area, site shown in blue.

3.0 LOCAL AUTHORITY GUIDANCE

BAP have contacted the London Borough of Bromley and were advised that they do not have a noise policy for such scenarios. In the lack of objective criteria, requirements from another London borough have considered for guidance purposes. The policy used has been taken from Camden Statement of Licencing policy 2011.

"*The conditions suggested in this section apply to any premises who wish to provide recorded music, live music dance performance, or provision of facilities for music and dancing as part of their licensable activities.*"

"*Before 2300 hours, the noise climate of the surrounding area shall be protected such that the A-weighted equivalent continuous noise level (L_{Aeq}) emanating from the application site, as measured one metre from any façade of any noise sensitive premises over any five minute period with entertainment taking place, shall not increase by more than 5dB as compared to the same measure, from the same position, and over a comparable period, with no*

entertainment taking place; and the unweighted equivalent noise level (L_{eq}) in the 63Hz Octave band, measured using the "fast" time constant, inside any living room of any noise sensitive premises, with the windows open or closed, over any five minute period with entertainment taking place, should show no increase as compared to the same measure, from the same location(s), and over a comparable period, with no entertainment taking place."

"After 2300 hours, the noise climate of the surrounding area shall be protected such that the A-weighted equivalent continuous noise level (L_{Aeq}) emanating from the application site, as measured one metre from any façade of any noise sensitive premises over any five minute period with entertainment taking place shall not increase by more than 3dB as compared to the same measure, from the same position, and over a comparable period, with no entertainment taking place and the unweighted equivalent noise level (L_{eq}) in the 63Hz Octave band, measured using the "fast" time constant, inside any living room of any noise sensitive premises, with the windows open or closed, over any five minute period with entertainment taking place, should show no increase as compared to the same measure, from the same location(s), and over a comparable period, with no entertainment taking place."

"No sound emanating from regulated entertainment shall be audible from a metre from the façade of the nearest noise sensitive premises".

BAP have undertaken an assessment of sound transmission to the nearest dwellings which reside on the eastern and western façades of the building. As access was not available to these premises, background noise measurements have been taken at secure locations on both the eastern and western facades as discussed in the following section.

4.0 NOISE SURVEY

4.1 Unattended survey – Baseline ambient conditions

In order to assess the existing ambient/background noise conditions around the premises, two unattended sound level meters were placed at the western and eastern facades of the converted cinema building complex. The meter at the western façade was positioned at roof level, overlooking Church Road (Position U1, a façade position). The meter at the eastern façade was positioned on a tripod at a height of 2m (Position U2, a façade position). Both positions are shown in Figure 2. The meters were set up to record noise levels of 5 minute duration continuously throughout the survey period.

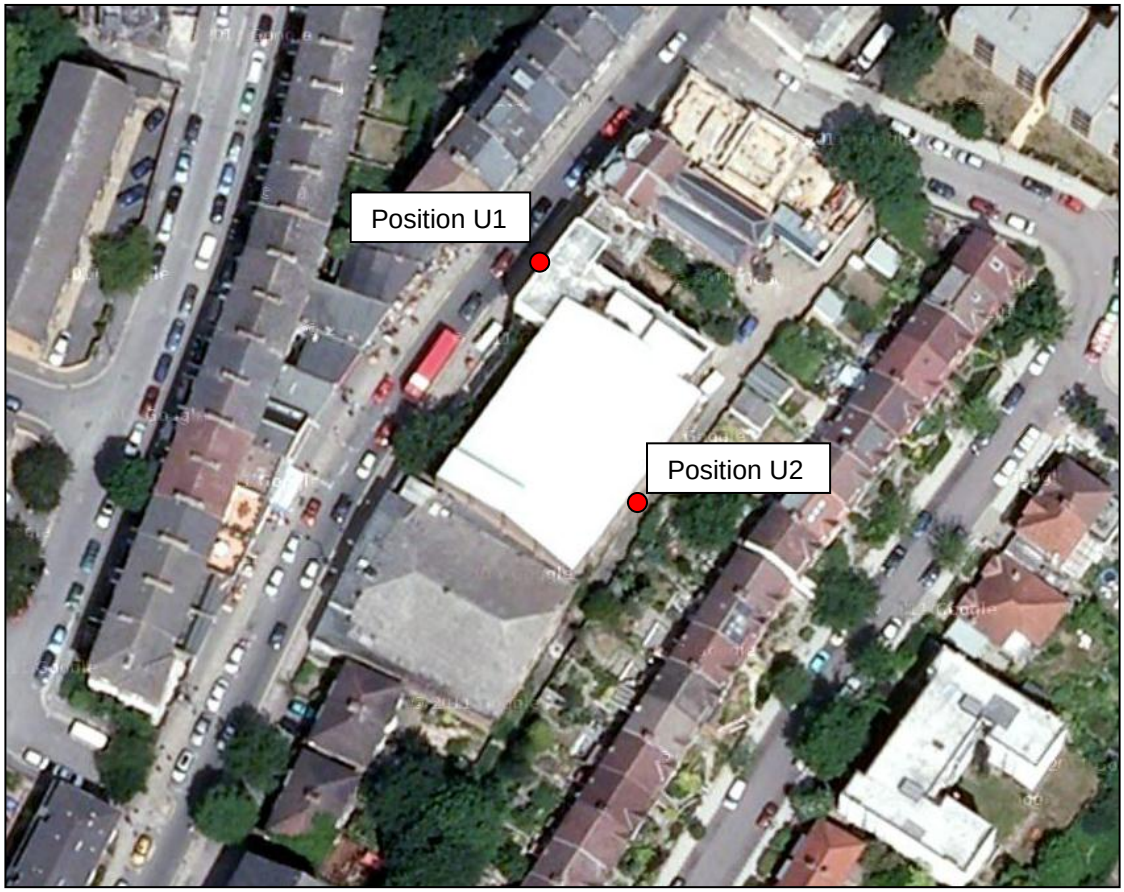

Figure 2 – Microphone positions

The equipment used consisted of two Norsonic type 118 sound level meters with a Brüel and Kjær type 4231 calibrator. The equipment was calibrated prior to and after the survey and no significant drift was observed.

4.2 Attended survey – Building envelope performance

In order to establish the current performance of the building envelope, a number of synchronous measurements were undertaken inside and outside simultaneously at various positions around the eastern façade and western façade. A typical soundtrack was output through the premises public address system at which point measurements were taken using two sound level meters, both measuring for 30 second durations. Measurements were taken at 1.2m above ground height both internally and externally. Internal measurement positions were chosen to take a spatial average of the main space. External measurement positions were chosen to take a spatial average around the building envelope element. These are shown below in Figure 3 and labelled for the eastern façade (E1-E5), western façade (W1-W5) and roof void (R1-R5).

Figure 3 – Microphone positions for eastern façade, western façade and roof void

The equipment used for all attended measurements consisted of a Brüel and Kjær 2260 type 1 sound level meter calibrated using a Brüel and Kjær 4231 calibrator. The equipment was calibrated prior to and after the survey and no significant drift was observed.

4.3 Unattended noise survey results

The average $L_{Aeq,T}$ spectrum recorded at both the western position U1, and eastern position U2 can be seen in Table 1. Levels have been presented for both daytime hours and night time hours.

Position	Average ambient noise level, dB $L_{Aeq,T}$						
	63Hz	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**A**
U1 day (07:00 to 23:00)	76	70	67	64	66	63	**70**
U1 night (23:00 to 02:00)	72	66	65	62	64	59	**67**
U2 day (07:00 to 23:00)	57	54	50	48	46	38	**50**
U2 night (23:00 to 02:00)	51	44	40	37	36	28	**40**

Table 1 – Unattended noise survey results, average dB $L_{Aeq,T}$ (façade)

4.4 Attended level difference results

The following Table 2 displays the level differences calculated and averaged from attended measurements made internally and externally.

Location	dB, Level difference Octave band data (internal – external)						
	63Hz	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**
Eastern façade (rear of building)	25	32	38	47	49	48	46
Western façade (front of building)*	20	32	33	40	37	34	34

*The level difference to the front of the building was affected by high levels of traffic noise on Church Road, as the façade build ups are identical the level difference measured to the rear of the building has been used for the purpose of this assessment.

Table 2 – Attended measurement results – level difference between internal to external

5.0 ASSESSMENT OF NOISE TRANSMISSION TO ADJACENT PROPERTIES

The following calculations have been undertaken by using:

- measured internal levels taken whilst speakers were in operation,

- the performance of the current building envelope as established through attended measurements,

- the average ambient noise levels in the vicinity as established through the nearest unattended position.

Full calculations showing all corrections are given in Appendix C.

5.1 Eastern façade (rear of building)

	Sound pressure level, dB $L_{Aeq,5min}$						
	63Hz	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**A**
Source level	105	102	97	97	91	85	**97**
Transmission loss of building envelope	25	32	38	47	49	48	
Predicted entertainment noise 1m outside nearest house	70	60	49	40	33	27	**48**
Daytime							
Background level daytime ($L_{eq,5min}$)	57	54	50	48	46	38	**50**
Total level (predicted level + background)	70	61	53	49	46	38	**52**
dB increase to background level	**13**	**7**	**3**	**1**	**0**	**0**	**2**
Noise reduction required	**21**	**0**	**0**	**0**	**0**	**0**	**0**
Night time							
Background level night time($L_{eq,5min}$)	51	44	40	37	36	28	**40**
Total level (predicted level + background)	70	60	50	42	38	31	**49**
dB increase to background level	**19**	**16**	**10**	**5**	**2**	**3**	**9**
Noise reduction required	**30**	**10**	**5**	**5**	**0**	**0**	**9**

Table 3 – Assessment upon the eastern façade, to neighbouring dwellings

5.2 Western façade (front of building)

	Sound pressure level, dB $L_{eq,5min}$						
	63Hz	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**A**
Source level	105	102	97	97	91	85	**97**
Transmission loss of building envelope	25	32	38	47	49	48	
Predicted entertainment noise 1m outside nearest house	68	58	47	38	30	25	**46**
Daytime							
Background level daytime ($L_{eq,5min}$)	76	70	67	64	66	63	**70**
Total level (predicted level + background)	77	70	67	64	66	63	**70**
dB increase to background level	**1**	**0**	**0**	**0**	**0**	**0**	**0**
Noise reduction required	**2**	**0**	**0**	**0**	**0**	**0**	**0**
Night time							
Background level night time($L_{eq,5min}$)	72	66	65	62	64	59	**67**
Total level (predicted level + background)	73	67	65	62	64	59	**67**
dB increase to background level	**1**	**1**	**0**	**0**	**0**	**0**	**0**
Noise reduction required	**6**	**0**	**0**	**0**	**0**	**0**	**0**

Table 4– Assessment upon the western façade, to neighbouring dwellings

5.3 Summary of assessment data

The following conclusions can be drawn from the above Tables 3 and 4:

- The nearest dwellings on the eastern façade are most affected, during the daytime the A-weighted level meets the guidance limit but exceeds the 63 Hz limit by 21 dB. At night the A-weighted value exceeds the guidance noise level by 9 dB and the 63 Hz value by 30 dB.

- The nearest dwellings on the western façade experience no increase in A-weighted levels during the day and night; however at the 63Hz octave band the noise level exceeds the required limit by 2 dB during the day and 6 dB during the night.

6.0 MITIGATION

In order to reduce noise levels at the nearest premises the following mitigation methods are proposed.

1. The existing fire exit door on the eastern facade should be replaced with a steel acoustic door-set with perimeter and threshold seals. The door-set should provide a minimum laboratory sound reduction index performance as follows:

Octave band	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz
Sound reduction (dB R_w)	32	34	37	38	38	41

   There would be no benefit in providing a door lobby arrangement, which would perform better acoustically than this single acoustic door, because the brickwork of the building limits the building envelope sound insulation performance.

2. All penetrations on the eastern facade (windows, air bricks and louvred grills) should be blocked up. The blocking material should be heavy in mass such as brick or dense block plastered internally. An effective air tight seal should be ensured.

3. A noise limiter should be installed within the building limiting the internal L_{eq} values when measured as an average across the main floor area. Limits have been provided for both daytime (07:00 to 23:00) and night time (23:00 to 02:00) and are as follows:

Octave band	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	dB(A)
Day Limited level (dB L_{eq})	92	102	97	97	91	85	97
Night Limited level (dB L_{eq})	86	94	91	92	90	85	94

With the noise limiter in place no works are required to the western façade to ensure the guidance limits are achieved.

The above assessment has been undertaken using Camden's criteria as general guidance and adopting the concept of ensuring noise levels are controlled on the basis of average ambient noise levels measured outside the nearest noise sensitive properties.

Strictly the London Borough of Camden's criteria indicates an assessment should be based on minimum ambient noise levels dB $L_{Aeq,5min}$ measured outside the nearest noise sensitive properties. This approach would place a more stringent criterion on the activities within the building which may be construed restrictive in light of its previous use as a cinema.

In this instance the following noise limit would be required (No additional sound insulation works over and above those described above would be required should these limits be adopted) -

Octave band	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	dB(A)
Day Limited level (dB L_{eq})	87	94	90	90	88	83	92
Night Limited level (dB L_{eq})	83	92	88	88	83	83	90

7.0 SUMMARY

Bickerdike Allen Partners have undertaken an assessment of entertainment noise from the property at 25 Church Road, London SE19. This assessment has included measurements of the background noise levels surrounding the site as well as attended measurements which establish the current performance of the building envelope.

The assessment has been carried out generally in accordance with typical objective guidance taken from the London Borough of Camden. It indicates that the building envelope as it currently performs will fail to provide adequate sound insulation to the nearest dwellings around the site. Recommendations have been provided in order to control noise breakout from the premises, these measures include the installation of a new door-set, blocking up of penetrations through the facades and implementation of a noise limiting system (see Section 6).

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Acoustician

Joe Baggaley
Acoustic Consultant

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Partner

APPENDIX A
GLOSSARY OF ACOUSTIC TERMINOLOGY

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2×10^{-5} pascals) and the threshold of pain is around 120 dB.

The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, L_w is expressed in decibels, referenced to 10^{-12} watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Environmental Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

$L_{Aeq, T}$ The most widely applicable unit is the equivalent continuous A-weighted sound pressure level ($L_{Aeq, T}$). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound.

L_{A90} The level exceeded for 90% of the time is normally used to describe background noise.

Sound Transmission in the Open Air

Most sources of sound can be characterised as a single point in space. The sound energy radiated is proportional to the surface area of a sphere centred on the point. The area of a sphere is proportional to the square of the radius, so the sound energy is inversely proportional to the square of the radius. This is the inverse square law. In decibel terms, every time the distance from a point source is doubled, the sound pressure level is reduced by 6 dB.

Road traffic noise is a notable exception to this rule, as it approximates to a line source, which is represented by the line of the road. The sound energy radiated is inversely proportional to the area of a cylinder centred on the line. In decibel terms, every time the distance from a line source is doubled, the sound pressure level is reduced by 3 dB.

Factors Affecting Sound Transmission in the Open Air

Reflection

When sound waves encounter a hard surface, such as concrete, brickwork, glass, timber or plasterboard, it is reflected from it. As a result, the sound pressure level measured immediately in front of a building façade is approximately 3 dB higher than it would be in the absence of the façade.

Screening and Diffraction

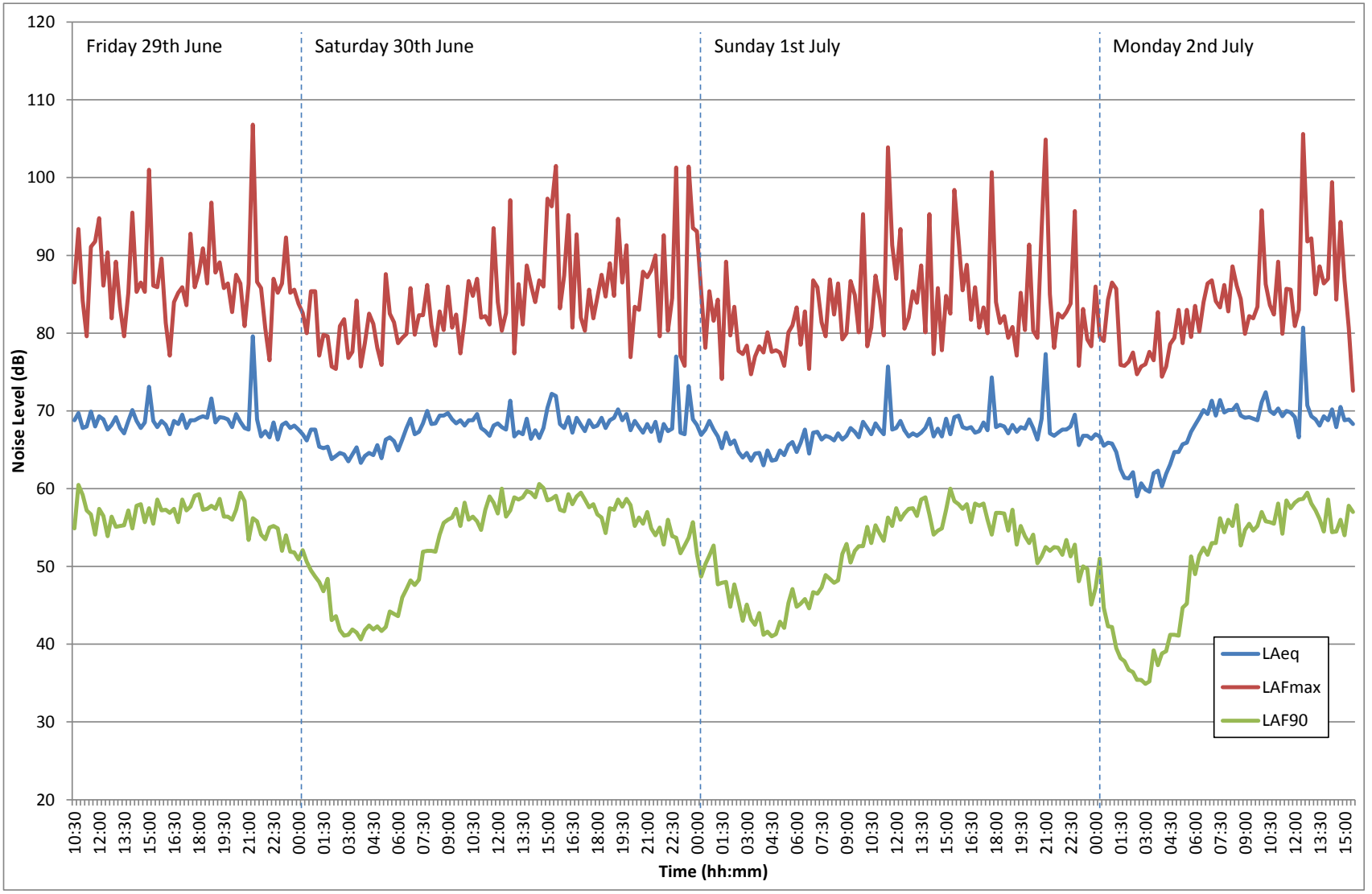
If a solid screen is introduced between a source and receiver, interrupting the sound path, a reduction in sound level is experienced. This reduction is limited, however, by diffraction of the sound energy at the edges of the screen. Screens can provide valuable noise attenuation, however. For example, a timber boarded fence built next to a motorway can reduce noise levels on the land beyond, typically by around 10 dB(A). The best results are obtained when a screen is situated close to the source or close to the receiver.

Meteorological Effects

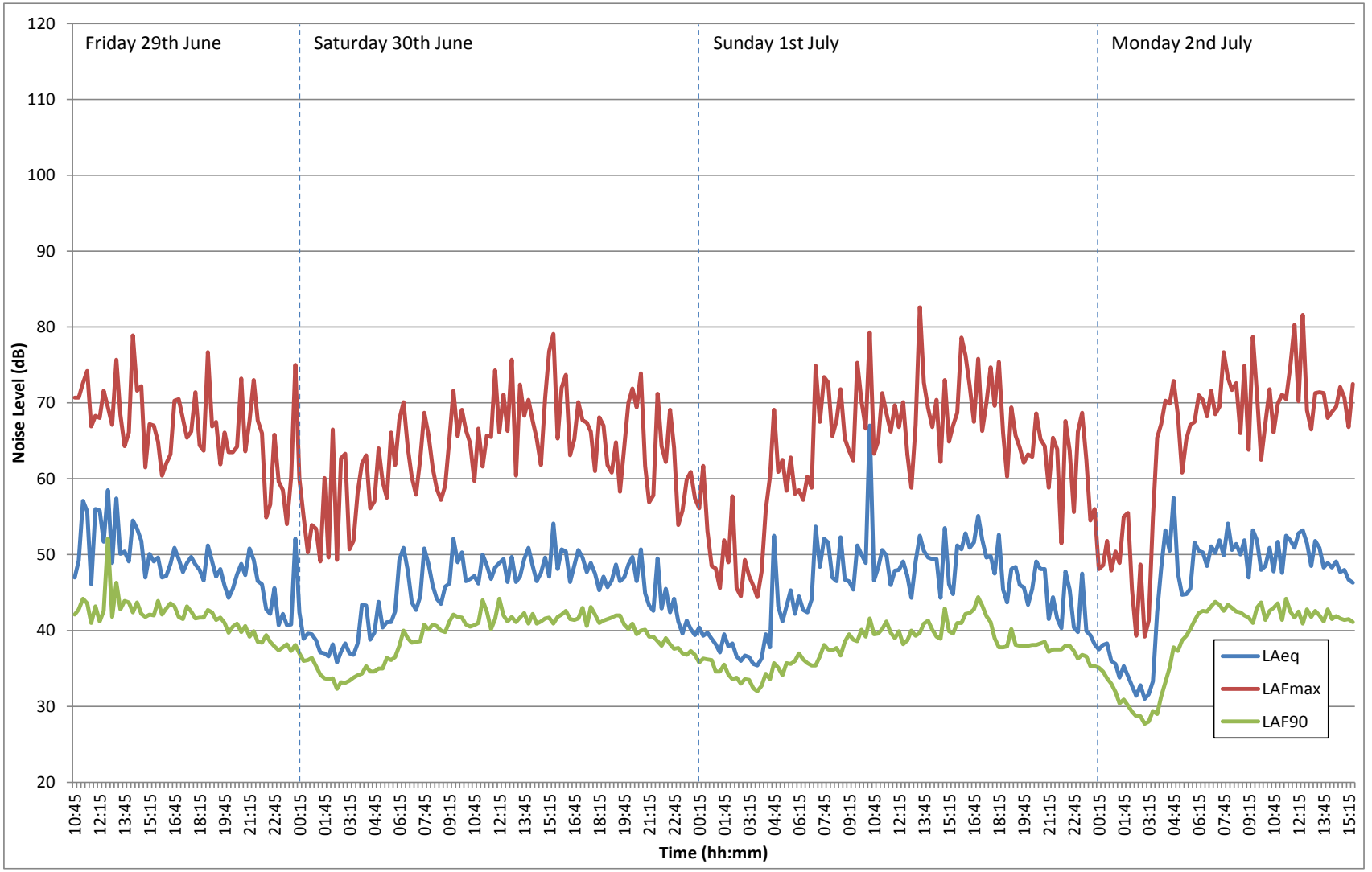
Temperature and wind gradients affect noise transmission, especially over large distances. The wind effects range from increasing the level by typically 2 dB downwind, to reducing it by typically 10 dB upwind – or even more in extreme conditions. Temperature and wind gradients are variable and difficult to predict.

APPENDIX B

DETAILED NOISE SURVEY RESULTS



Unattended position U1 – Time history plot (façade position)



Unattended position U2 – Time history plot (façade position)

APPENDIX C

DETAILED CALCULATIONS

25 Church Road
A9540
East façade no mitigation

Transmission through walls to atmosphere **Octave band centre frequency, Hz**

Formula	**Description**	**Data**	**63**	**125**	**250**	**500**	**1000**	**2000**	**dB(A)**
VIA ENTIRE FAÇADE									
L1			105	102	97	97	91	85	97
-R	Current		25	32	38	47	49	48	
+10logS		m^2: 176	22	22	22	22	22	22	
+DI	Directivity		3	3	3	3	3	3	
-20log r		m: 15.0	24	24	24	24	24	24	
-14		14.0	14	14	14	14	14	14	
L_2			68	58	47	38	30	25	46
$L_{2\,TOT}$	Free-field		68	58	47	38	30	25	46
$L_{2\,TOT}$	Façade		70	60	49	40	33	27	48
Measured $L_{Aeq,T}$	daytime		57	54	50	48	46	38	50.0
Combined			70	61	53	49	46	38	52.3
Increase			**13**	**7**	**3**	**1**	**0**	**0**	**2**
Measured $L_{Aeq,T}$	night time		51	44	40	37	36	28	40
Combined			70	60	50	42	38	31	49
Increase			**19**	**16**	**10**	**5**	**2**	**3**	**9**

25 Church Road
A9540
West façade no mitigation

Transmission through walls to atmosphere **Octave band centre frequency, Hz**

Formula	**Description**	**Data**	**63**	**125**	**250**	**500**	**1000**	**2000**	**dB(A)**
VIA ENTIRE FAÇADE									
L1			105	102	97	97	91	85	97
-R	Current		25	32	38	47	49	48	
+10logS		m^2: 176	22	22	22	22	22	22	
+DI	Directivity		3	3	3	3	3	3	
-20log r		m: 20.0	26	26	26	26	26	26	
-14		14.0	14	14	14	14	14	14	
L_2			65	55	44	35	28	22	43
$L_{2\,TOT}$	Free-field		65	55	44	35	28	22	43
$L_{2\,TOT}$	Façade		68	58	47	38	30	25	46
Measured $L_{Aeq,T}$	daytime		76	70	67	64	66	63	69.5
Combined			77	70	67	64	66	63	69.5
Increase			**1**	**0**	**0**	**0**	**0**	**0**	**0**
Measured $L_{Aeq,T}$	night time		72	66	65	62	64	59	67
Combined			73	67	65	62	64	59	67
Increase			**1**	**1**	**0**	**0**	**0**	**0**	**0**

25 Church Road
A9540
East façade with mitigation (daytime)

Transmission through walls to atmosphere **Octave band centre frequency, Hz**

Formula	Description		Data	63	125	250	500	1000	2000	dB(A)
VIA BRICKWORK										
L1				92	102	97	97	91	85	97
-R	9" brickwork (insul)			39	41	39	46	54	61	
+10logS		m^2:	176	22	22	22	22	22	22	
+DI	Directivity			3	3	3	3	3	3	
-20log r		m:	15.0	24	24	24	24	24	24	
-14			14.0	14	14	14	14	14	14	
L_2				41	49	46	39	25	12	41
VIA Door										
L1				92	102	97	97	91	85	97
-R	Steel acoustic doorset with perimeter and			32	34	37	38	38	41	
+10logS		m^2:	3.2	5	5	5	5	5	5	
+DI	Directivity			3	3	3	3	3	3	
-20log r		m:	15.0	24	24	24	24	24	24	
-14			14.0	14	14	14	14	14	14	
L_2				31	39	31	30	24	15	30
VIA Roof										
L1				81	83	76	73	67	58	74
-R	Kingspan KS1000 RW/80 + I + PL			18	19	22	29	31	40	
+10logS		m^2:	135.2	21	21	21	21	21	21	
+DI	Directivity			0	0	0	0	0	0	
-20log r		m:	25.0	28	28	28	28	28	28	
-14			14.0	14	14	14	14	14	14	
L_2				42	43	33	24	15	-2	30
$L_{2\,TOT}$	Free-field			45	50	46	40	28	16	41
$L_{2\,TOT}$	Façade			47	53	49	42	30	19	44
Measured $L_{Aeq,T}$	daytime			57	54	50	48	46	38	50.0
Combined				57	56	52	49	46	38	50.9
Increase				**0**	**2**	**2**	**1**	**0**	**0**	**1**

25 Church Road
A9540
East façade with mitigation (night time)

Transmission through walls to atmosphere **Octave band centre frequency, Hz**

Formula	Description	Data	63	125	250	500	1000	2000	dB(A)
VIA BRICKWORK									
L1			86	94	91	92	90	85	94
-R	9" brickwork (insul)		39	41	39	46	54	61	
+10logS		m^2: 176	22	22	22	22	22	22	
+DI	Directivity		3	3	3	3	3	3	
-20log r		m: 15.0	24	24	24	24	24	24	
-14		14.0	14	14	14	14	14	14	
L_2			35	41	40	34	24	12	35
VIA Door									
L1			86	94	91	92	90	85	94
-R	Steel acoustic doorset with perimeter and		32	34	37	38	38	41	
+10logS		m^2: 3.2	5	5	5	5	5	5	
+DI	Directivity		3	3	3	3	3	3	
-20log r		m: 15.0	24	24	24	24	24	24	
-14		14.0	14	14	14	14	14	14	
L_2			25	31	25	25	23	15	26
VIA Roof									
L1			75	75	70	68	66	58	70
-R	Kingspan KS1000 RW/80 + I + PL		18	19	22	29	31	40	
+10logS		m^2: 135.2	21	21	21	21	21	21	
+DI	Directivity		0	0	0	0	0	0	
-20log r		m: 25.0	28	28	28	28	28	28	
-14		14.0	14	14	14	14	14	14	
L_2			36	35	27	19	14	-2	23
$L_{2\,TOT}$	Free-field		39	42	40	35	27	16	36
$L_{2\,TOT}$	Façade		41	45	43	37	29	19	38
Measured $L_{Aeq,T}$	daytime		51	44	40	37	36	28	40
Combined			51	47	45	40	37	29	42.1
Increase			**0**	**3**	**5**	**3**	**1**	**1**	**2**